

FIG. 1

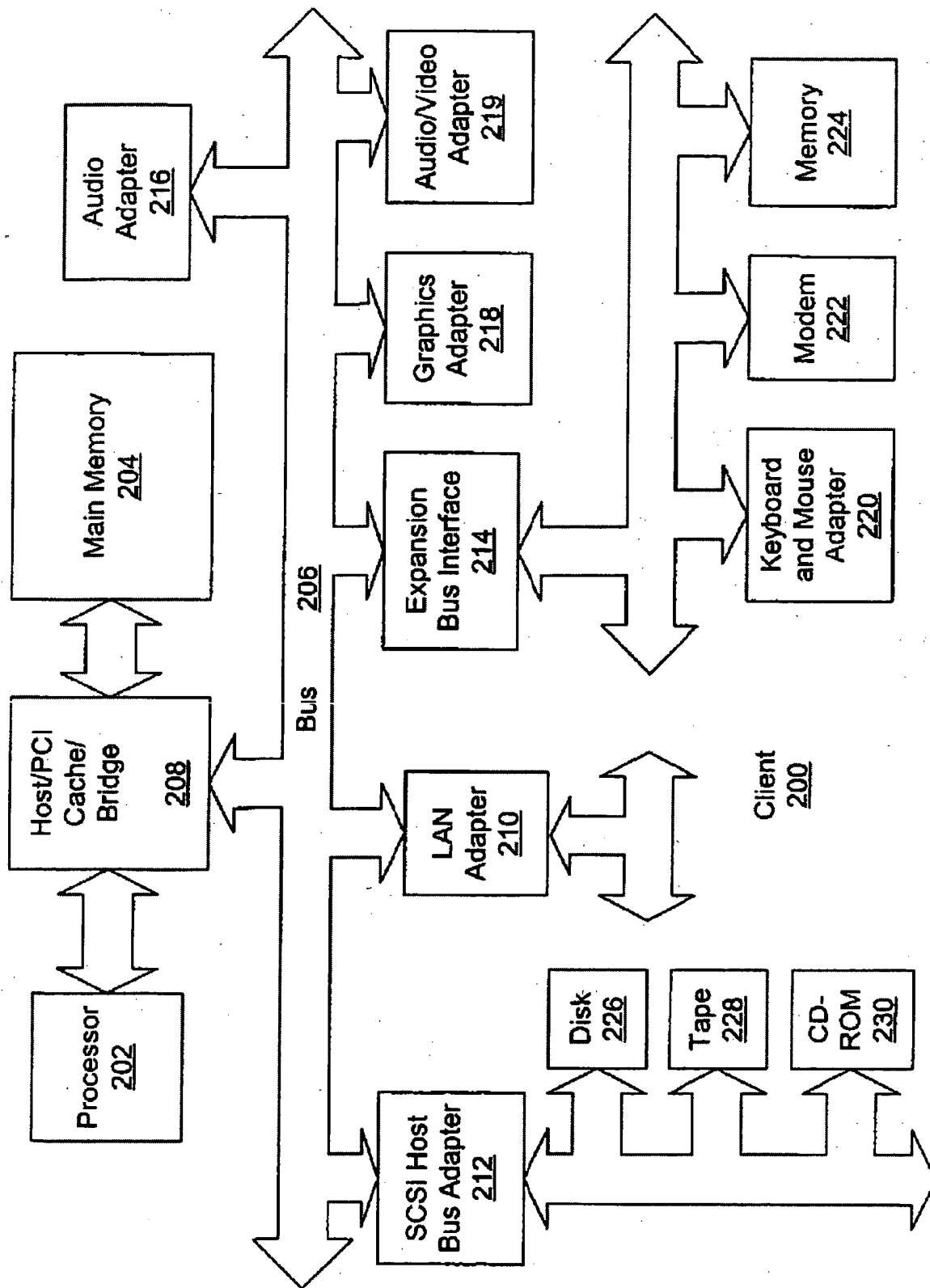


FIG. 2

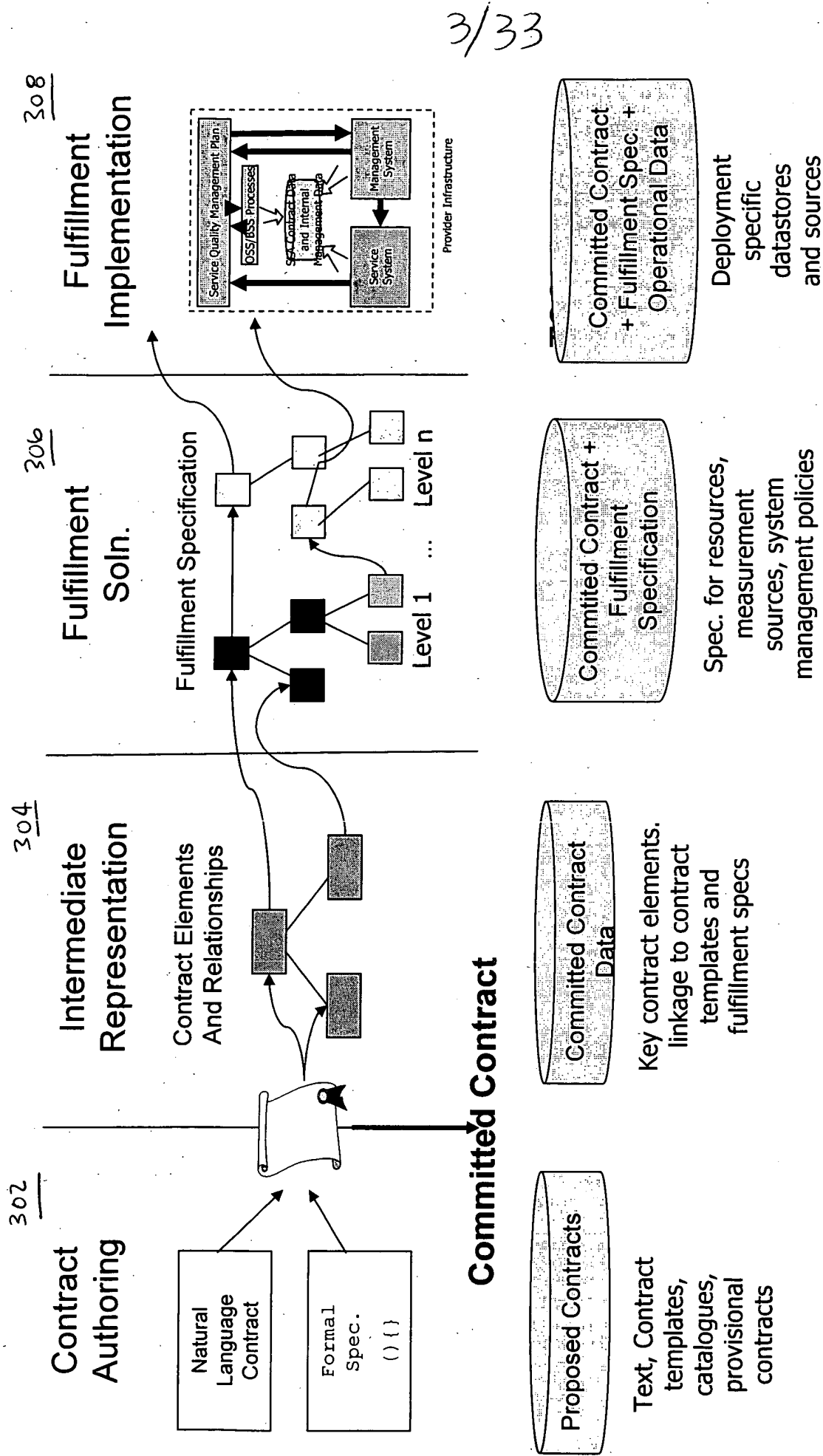
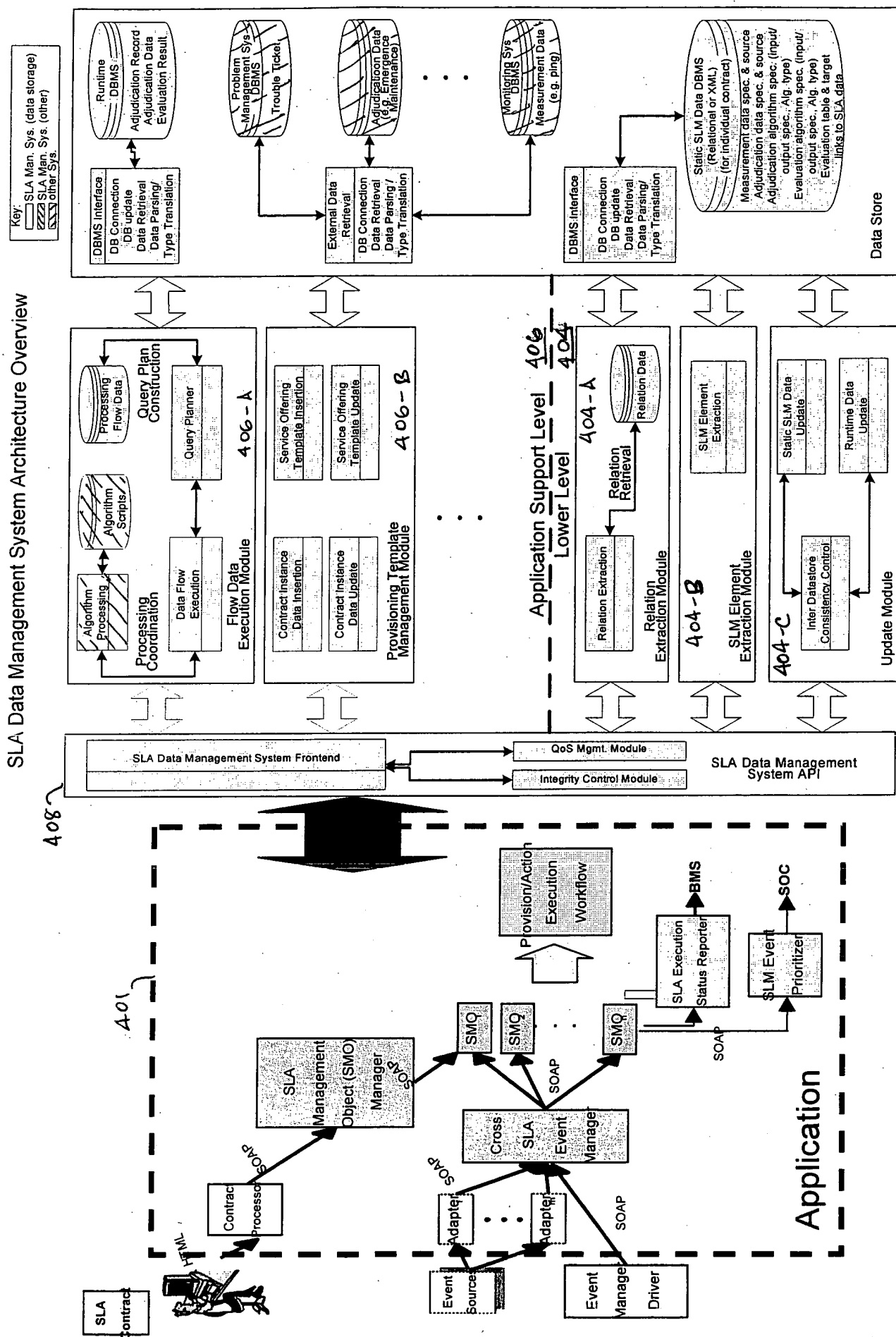


FIG. 3

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SLA Data Management System Architecture Overview



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FIG. 4

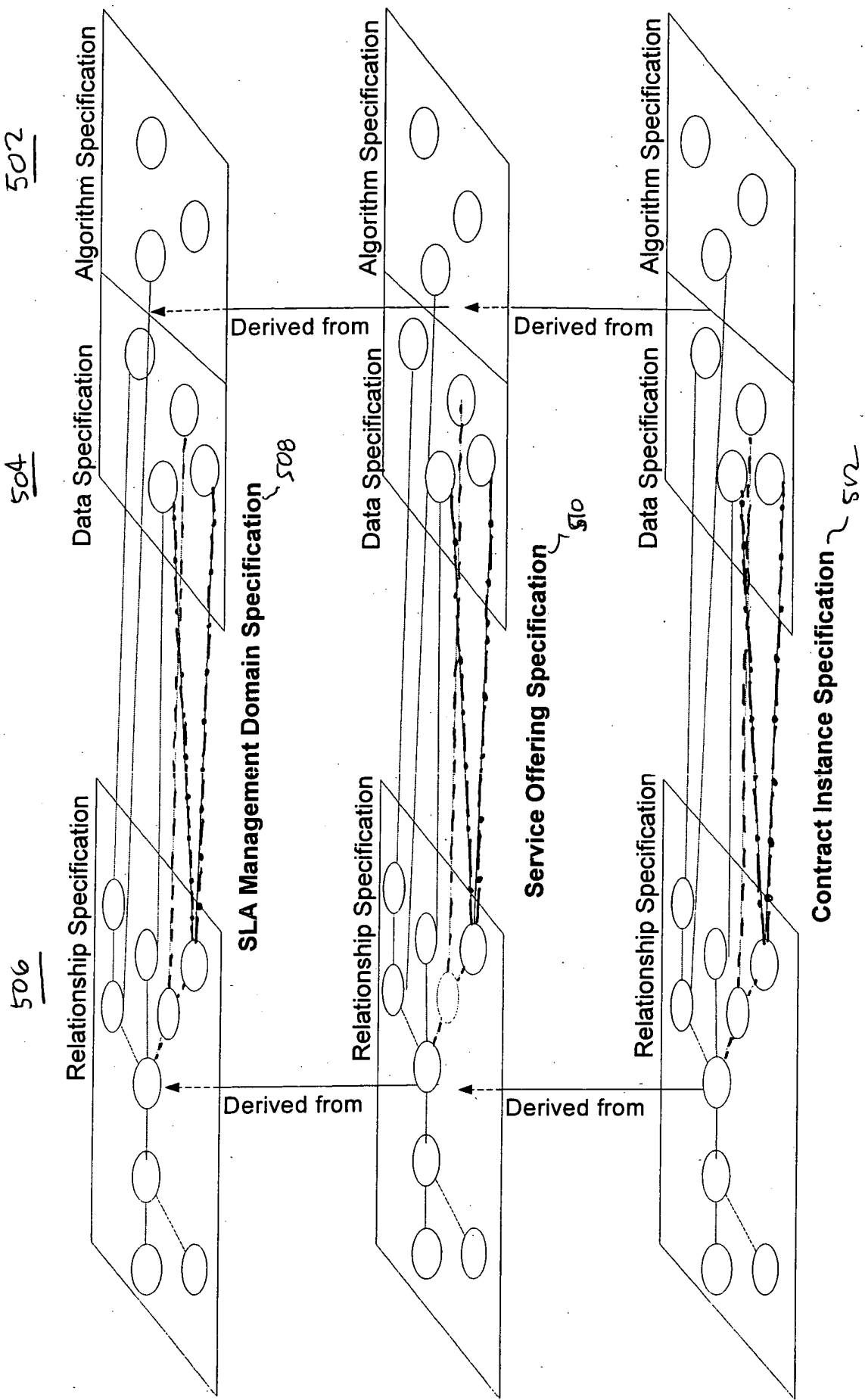


FIG. 5

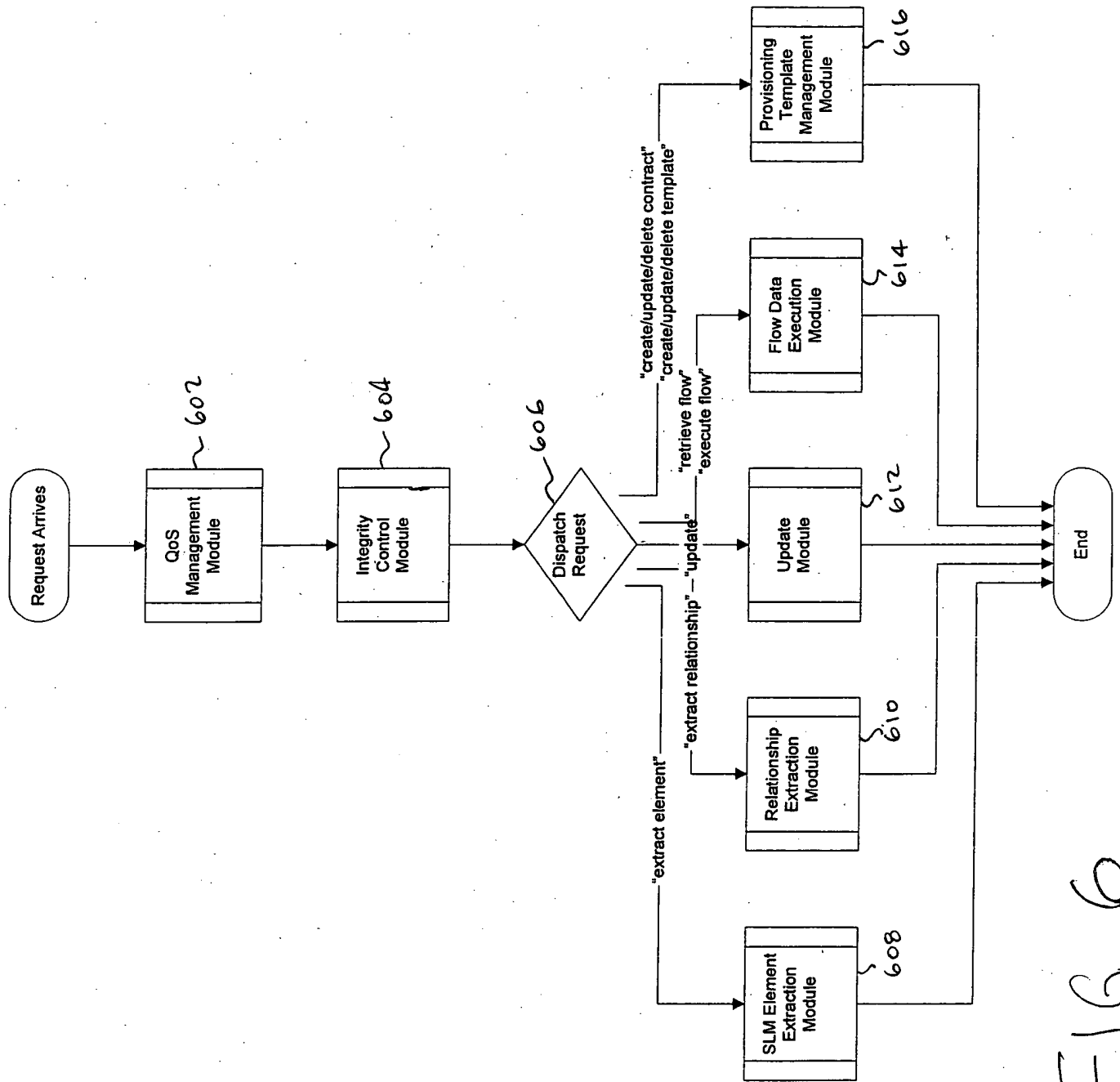
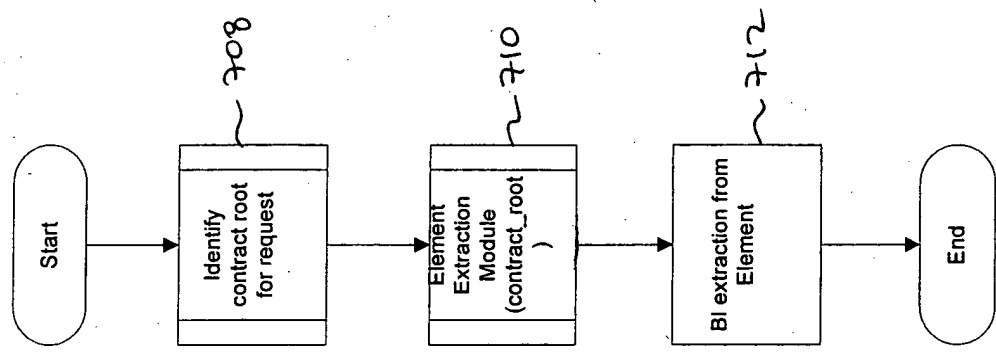
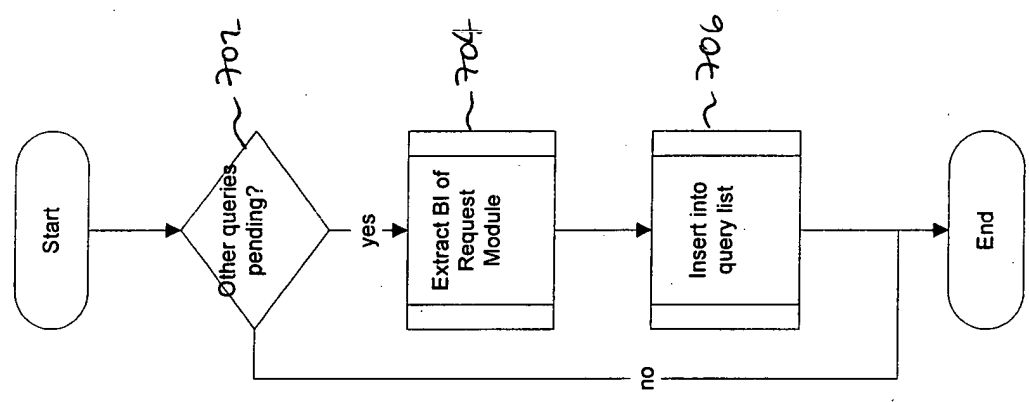


FIG. 6

(B)



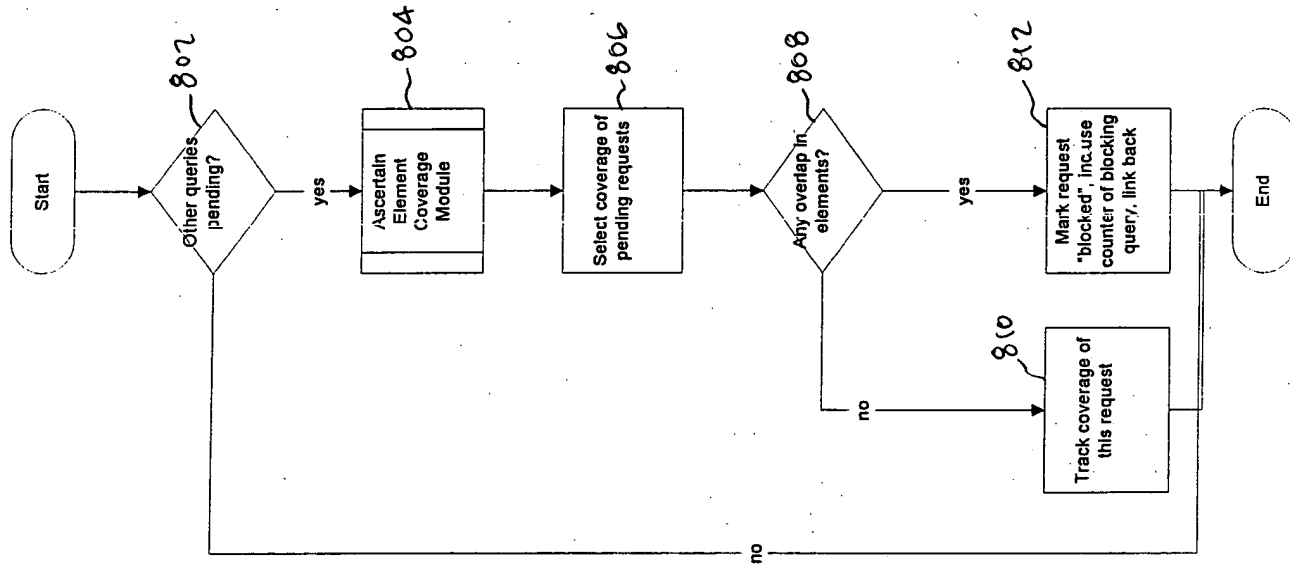
(A)



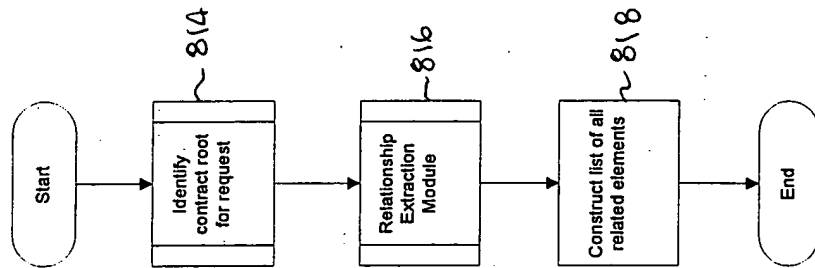
Ascertain BI of Request Module

FIG. 7

(A)



(B)



Ascertain Element Coverage Module

FIG. 8

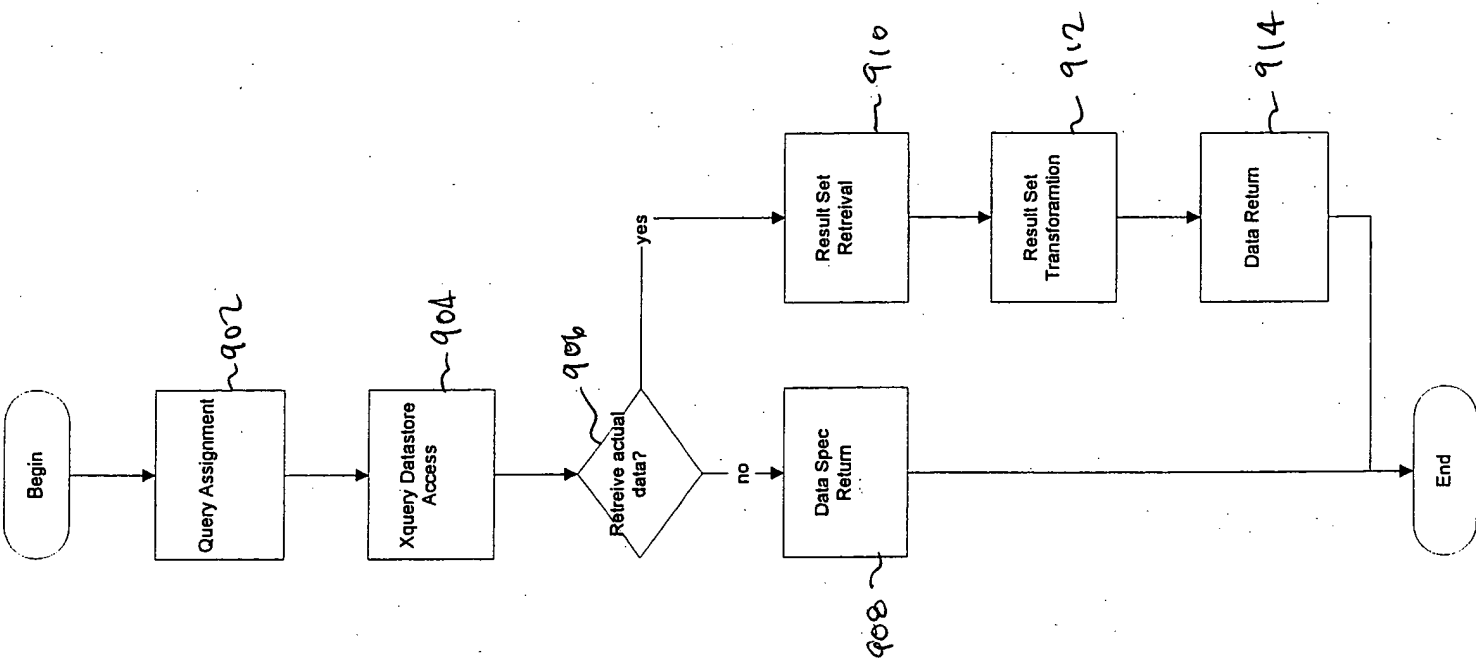


FIG. 9

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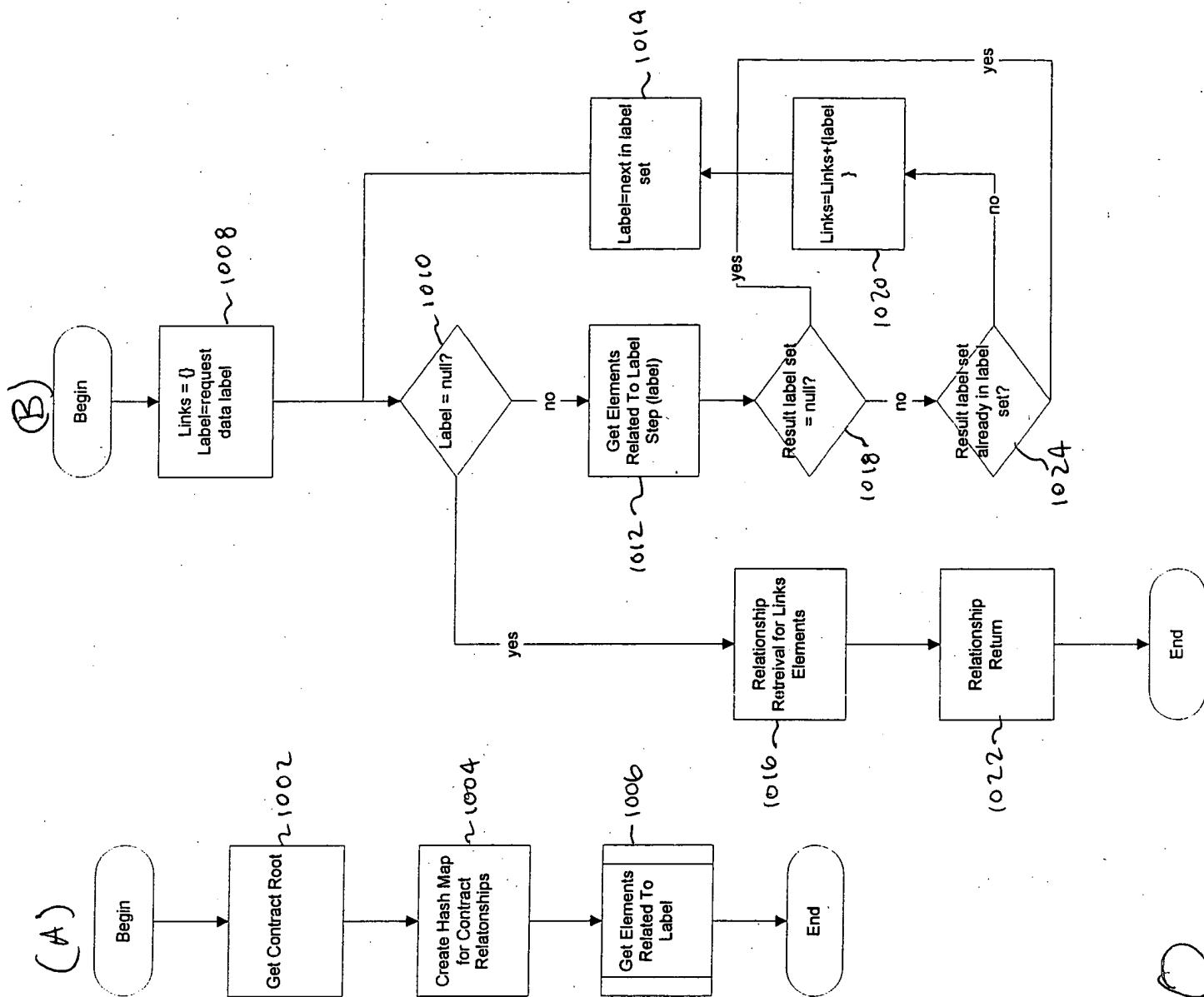


FIG. 10

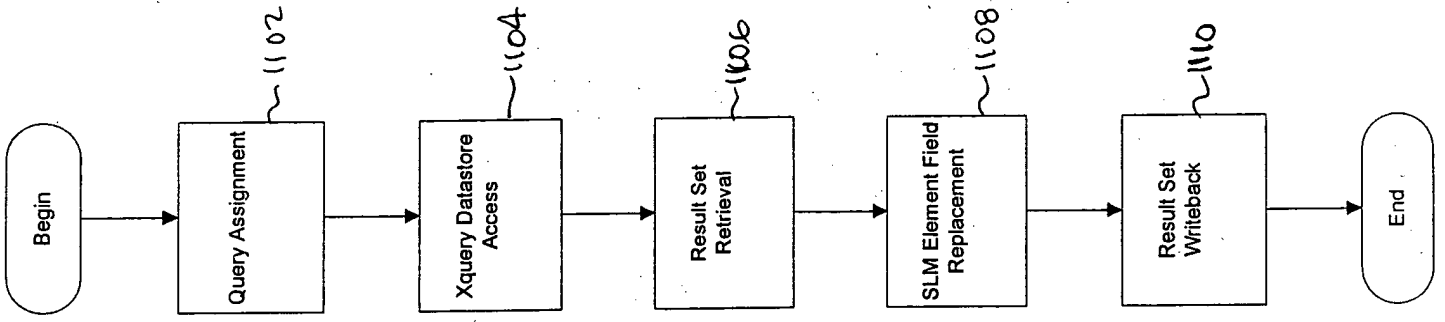


FIG. 11

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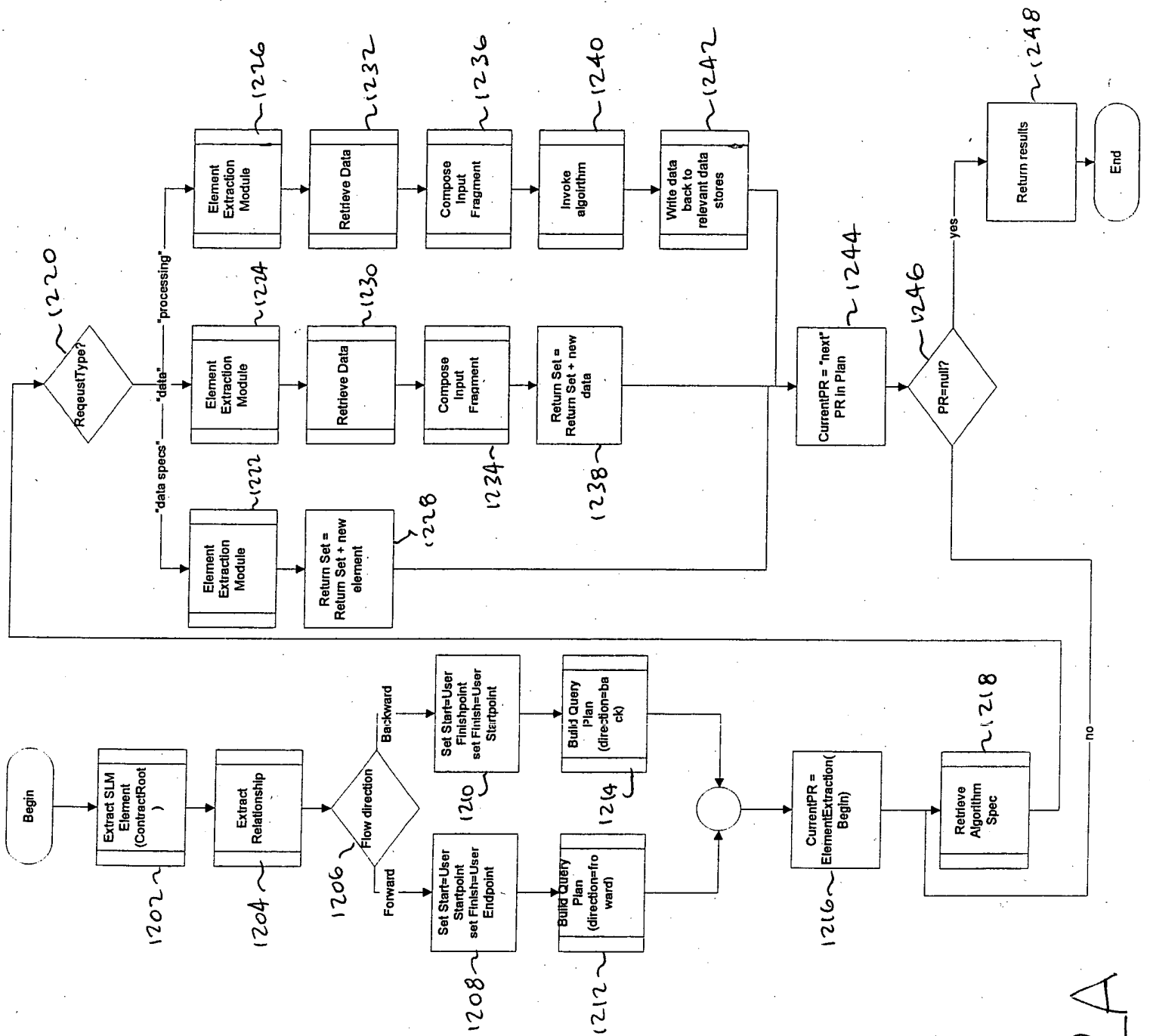


FIG. 12A

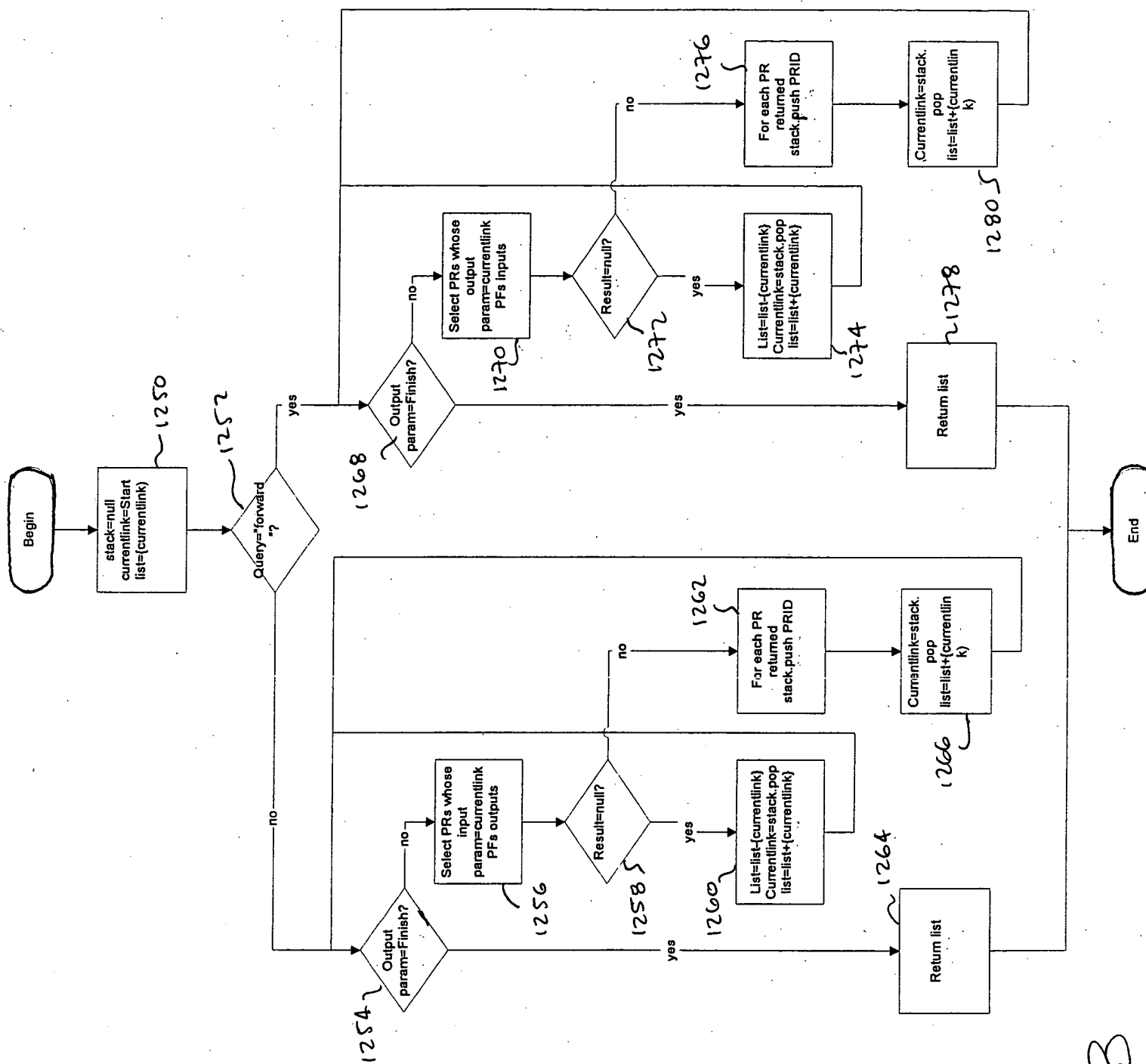


FIG. 12B

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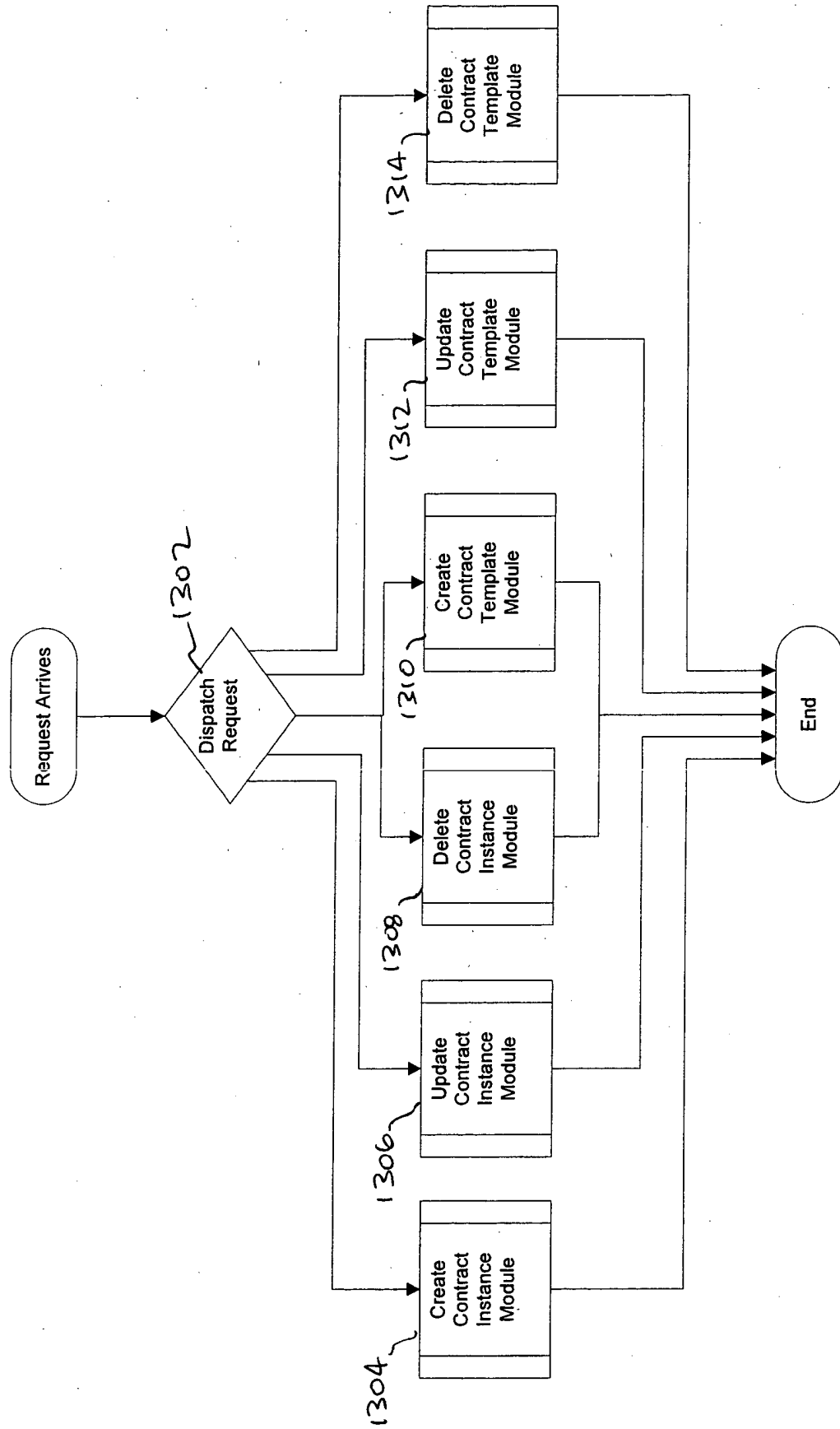


FIG. 13

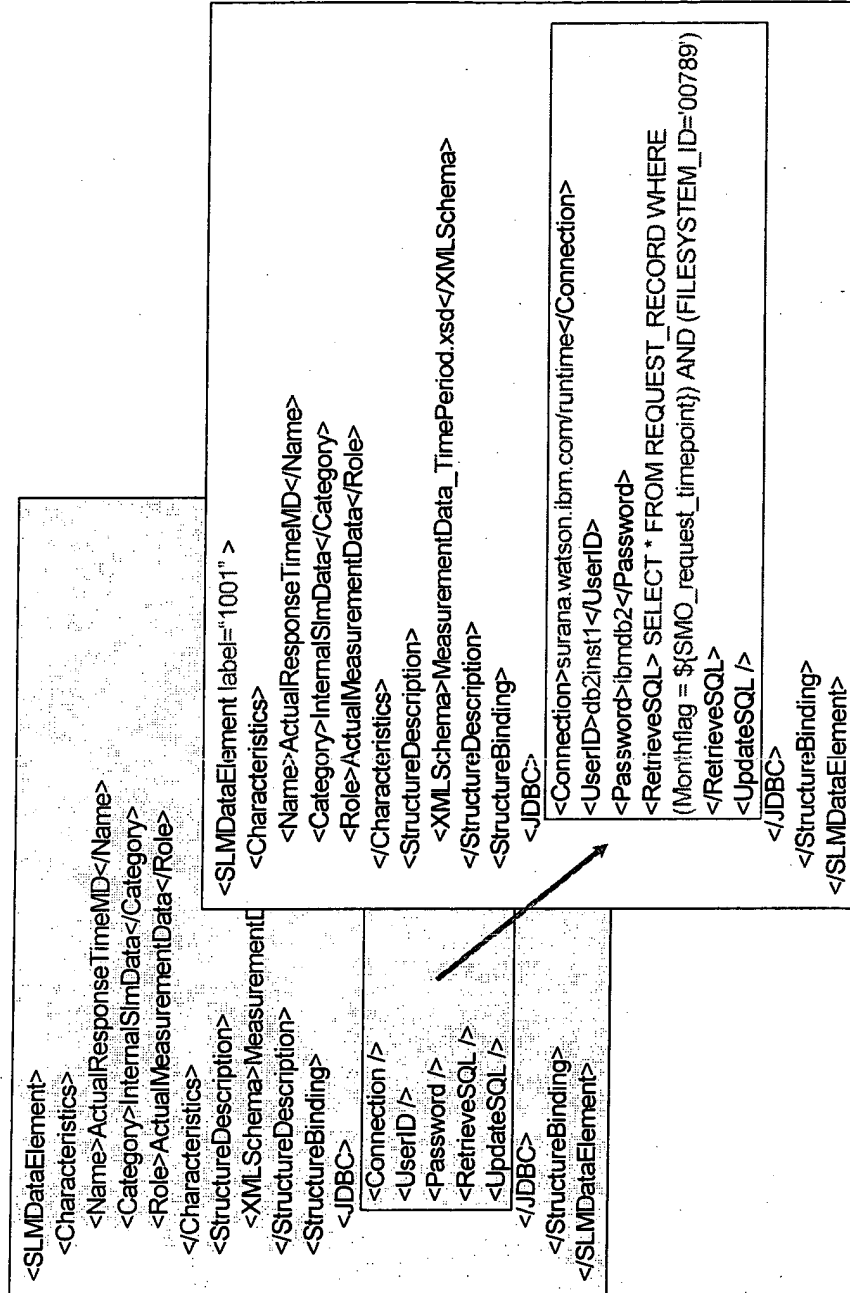


FIG. 14

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```

<SLMAIlgElement >
  <Characteristics>
    <Category>InternalSlmData</Category>
    <Role>SLEAlgorithm_Duration</Role>
  </Characteristics>
  <AlgorithmStub>
    <Input name="StartTime" data-type="Dynamic">
      <SLMEleName />
    <AttrName />
  </Input>
    <Input name="EndTime" data-type="Dynamic">
      <SLMEleName />
    <AttrName />
  </Input>
    <Output name="Duration" data-type="Dynamic">
      <SLMEleName />
    <AttrName />
  </Output>
  </AlgorithmStub>
  <ExecutionContext>
    <URI />
  </ExecutionContext>
</SLMAIlgElement>

```

```

<SLMAIlgElement >
  <Characteristics>
    <Name>ResponseTimeSLEAlgorithm</Name>
    <Category>InternalSlmData</Category>
    <Role>SLEAlgorithm</Role>
  </Characteristics>
  <AlgorithmStub>
    <Input name="StartTime" data-type="Dynamic">
      <SLMEleName>QualifiedResponseTimeMD</SLMEleName>
    <AttrName>StartTime</AttrName>
  </Input>
    <Input name="EndTime" data-type="Dynamic">
      <SLMEleName>QualifiedResponseTimeMD</SLMEleName>
    <AttrName>EndTime</AttrName>
  </Input>
    <Output name="Duration" data-type="Dynamic">
      <SLMEleName>ResponseTimeLength</SLMEleName>
    <AttrName>ResponseTimeLength</AttrName>
  </Output>
  </AlgorithmStub>
  <ExecutionContext>
    <URI />
  </ExecutionContext>
</SLMAIlgElement>

```

Fig. 15

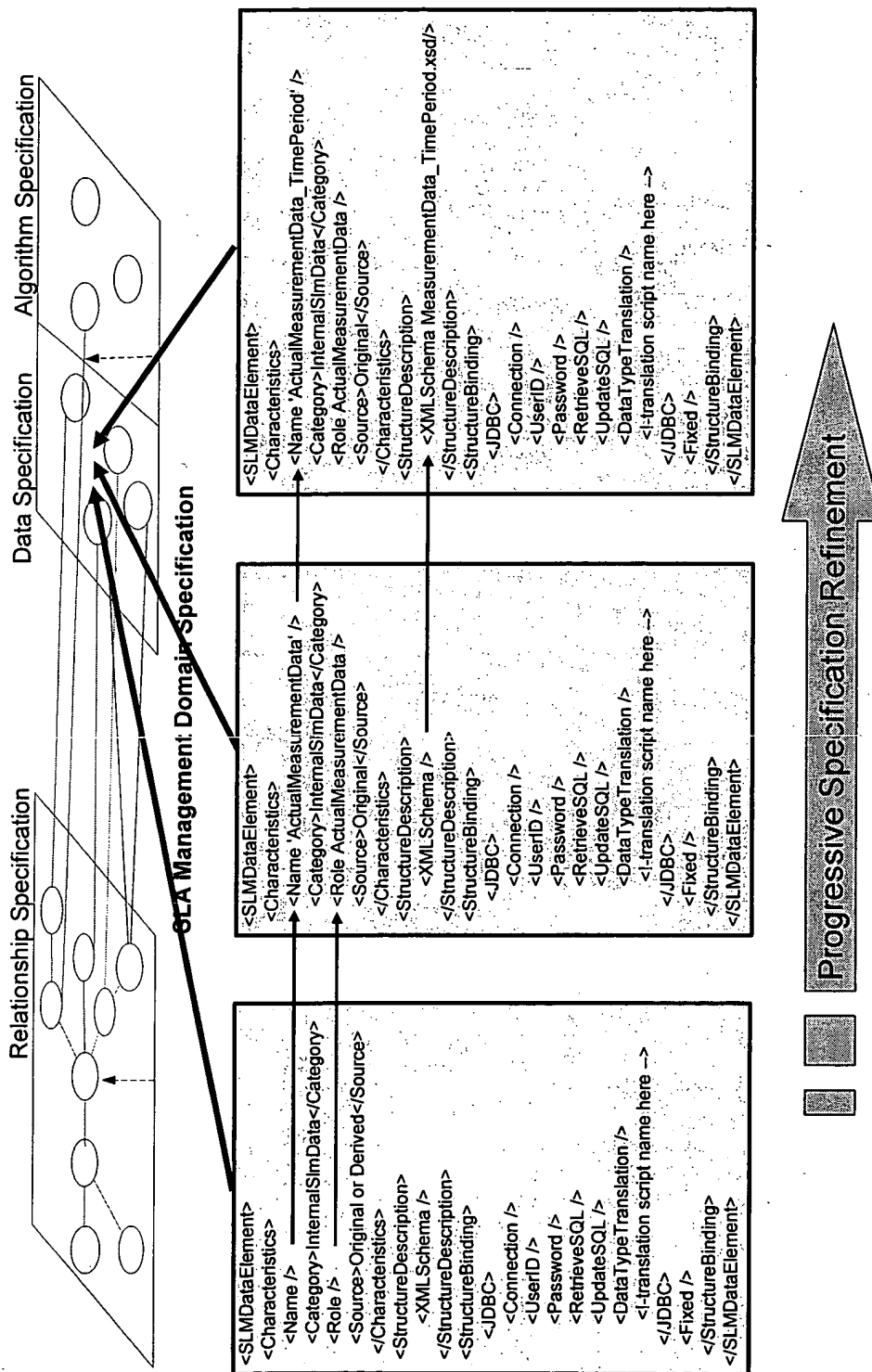


FIG. 16

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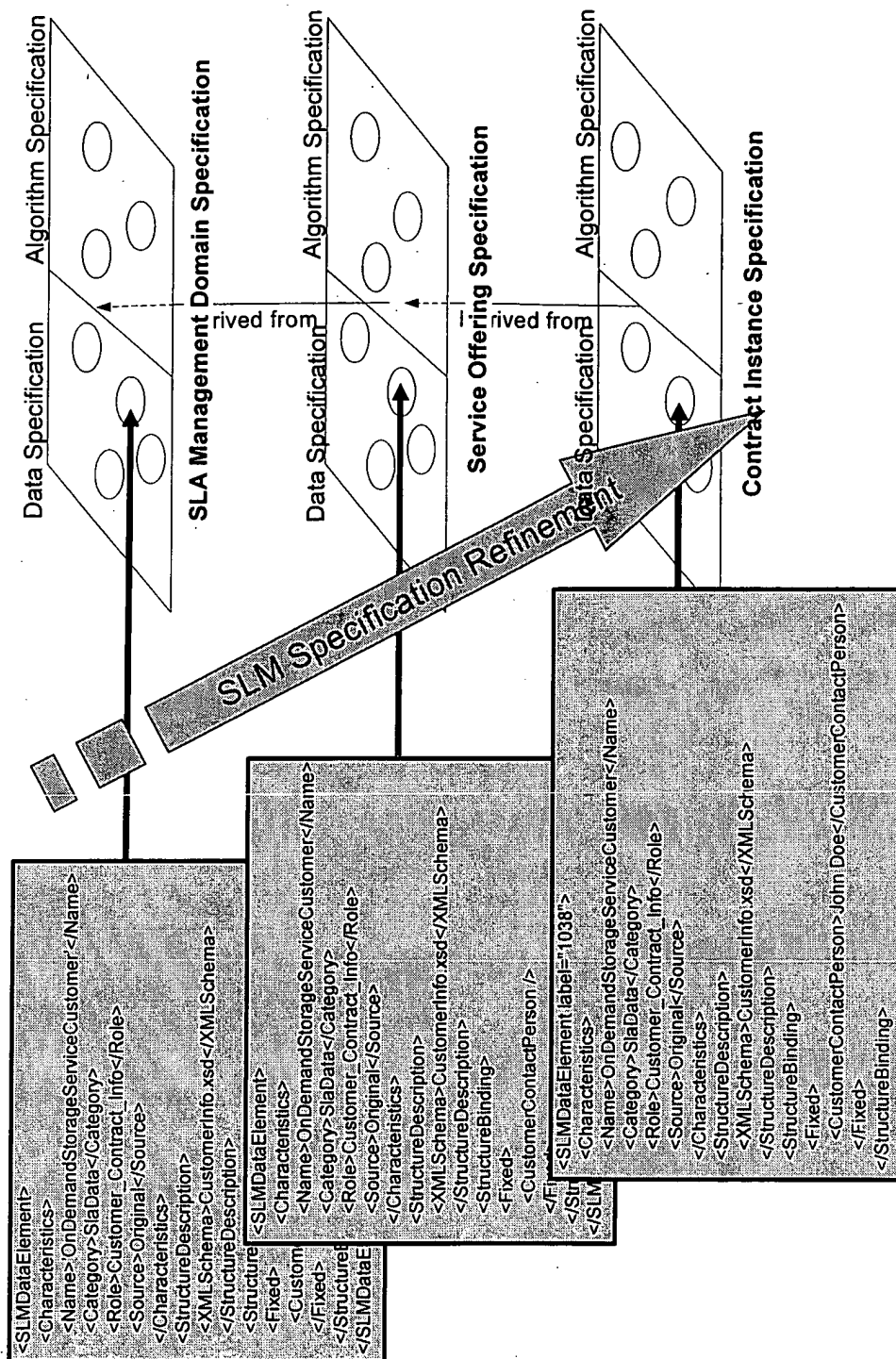


FIG. 17

```

<SLAM>
  <SchemaRelationshipList>
    <CentralData role="ContractRoot" category="SlaData" name="OnDemandStorageServiceContract">1033</CentralData>
    <LinkData role="Customer_Contract_Info" category="SlaData" name="OnDemandStorageServiceCustomer">1038</LinkData>
    <LinkData role="Provider_Contract_Info" category="SlaData" name="OnDemandStorageServiceProvider">1039</LinkData>
    <LinkData role="ServiceEntity" category="SlaData" name="FileSystemServiceEntity">1031</LinkData>
    <LinkRelation role="Orchestration" name="OnDemandStorageServiceOrchestration">R1000</LinkRelation>
    <LinkRelation role="SLASLMMapping" name="OnDemandStorageServiceSLASLMMapping">R1001</LinkRelation>
  </SchemaRelationshipList>
  ...
  <SchemaRelationshipList>
    <OrchestrationList>
      <Orchestration name="OnDemandStorageServiceOrchestration" label="R1000">
        ...
        <ProcessingRelationship>
          <seq>30</seq>
          <AlgorithmRef><Data role="SLEAlgorithm" type="Authoritative" name="ResTimeSLEAlgorithm_1_ContractualSL">1022</Data></AlgorithmRef>
          <InputParameter><Data role="QualifiedMeasurementData" name="QualifiedResponseTimeMD_ContractualSL">1005</Data></InputParameter>
          <OutputParameter><Data role="SLEvaluationData" name="ResponseTimeLength_ContractualSL">1007</Data></OutputParameter>
        </ProcessingRelationship>
        ...
        <ProcessingRelationship>
          <seq>40</seq>
          <AlgorithmRef><Data role="SLEAlgorithm" type="Authoritative" name="ResTimeSLEAlgorithm_2_ContractualSL">1023</Data></AlgorithmRef>
          <InputParameter><Data role="SLEvaluationData" name="ResponseTimeLength_ContractualSL">1007</Data></InputParameter>
          <OutputParameter><Data role="SLEvaluationData" name="OnTimeRequestPercent_ContractualSL">1010</Data></OutputParameter>
        </ProcessingRelationship>
        ...
        <Orchestration>
          </OrchestrationList>
          <SLASLMMappingList>
            <SLASLMMapping name="OnDemandStorageServiceSLASLMMapping" label="R1001">
              ...
              <InterCategoryRelationship role="SLEAlgorithm">
                <Group category="InternalSimData">
                  <Member name="ResTimeSLEAlgorithm_1_ContractualSL">1022</Member>
                  <Member name="ResTimeSLEAlgorithm_2_ContractualSL">1023</Member>
                </Group>
                <Group category="SlaData">
                  <Member name="ResTimeSLEAlgorithm_ContractualSL">1021</Member>
                </Group>
              </InterCategoryRelationship>
            </SLASLMMappingList>
            ...
          </SLASLMMappingList>
        </SLAM>
      </Orchestration>
    </OrchestrationList>
  </SchemaRelationshipList>

```

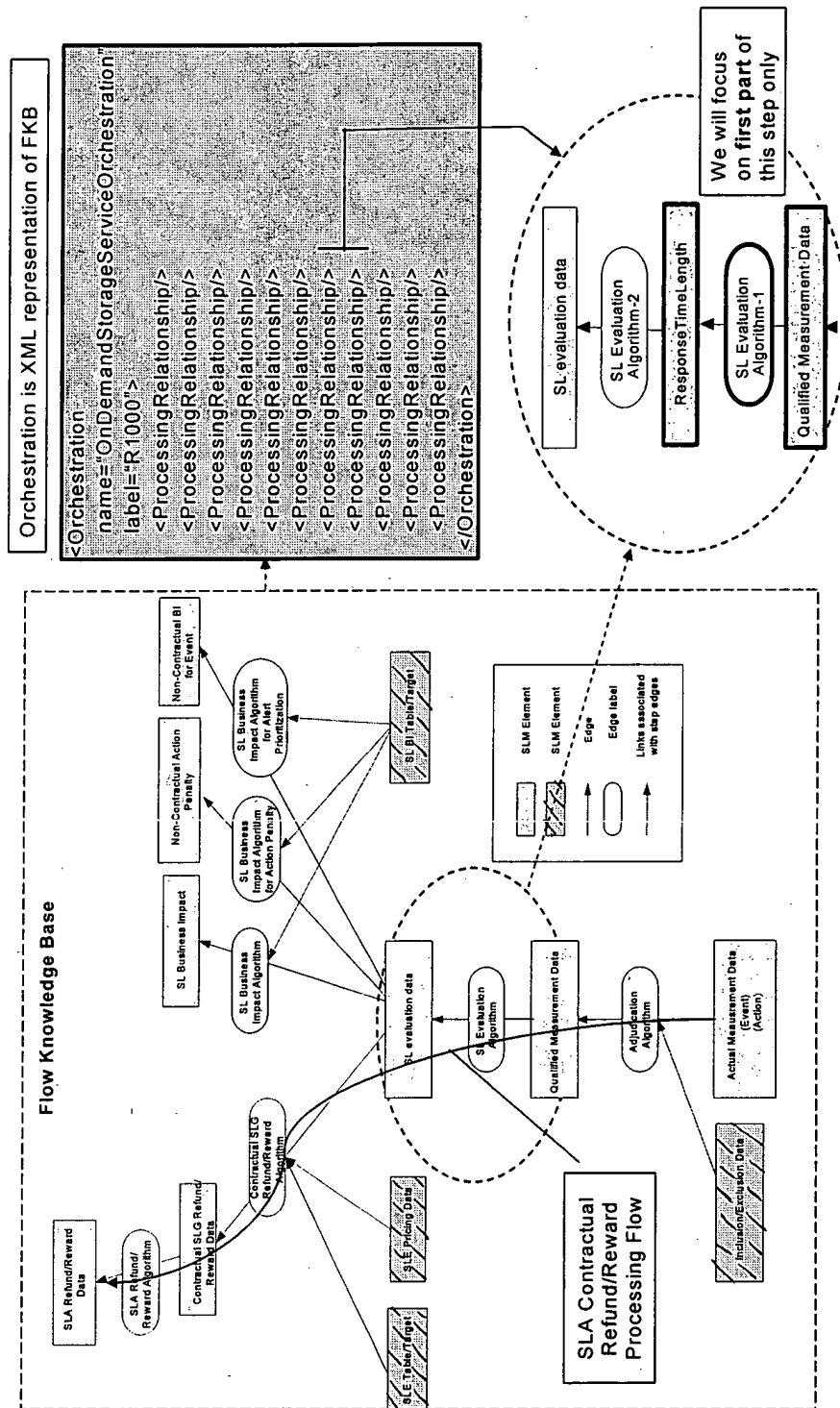
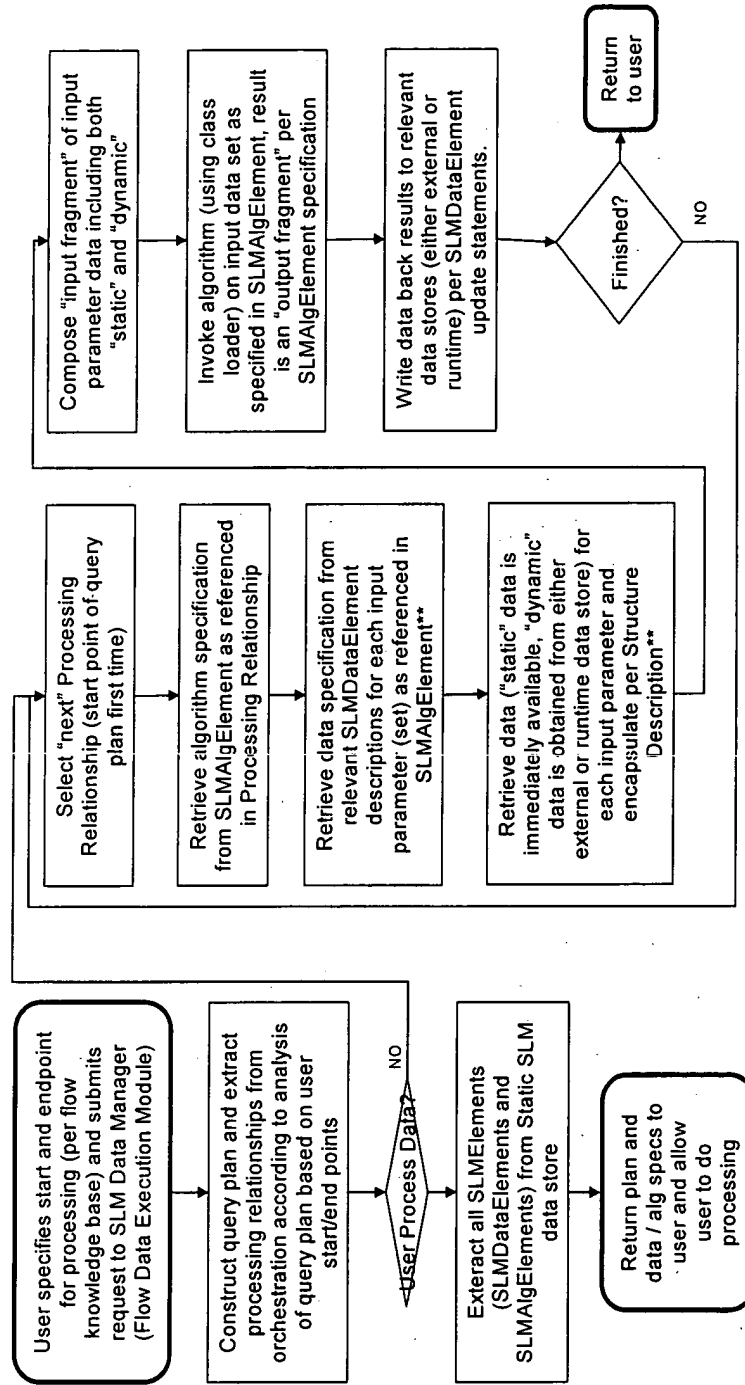



FIG. 19C

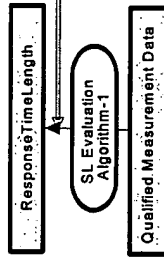
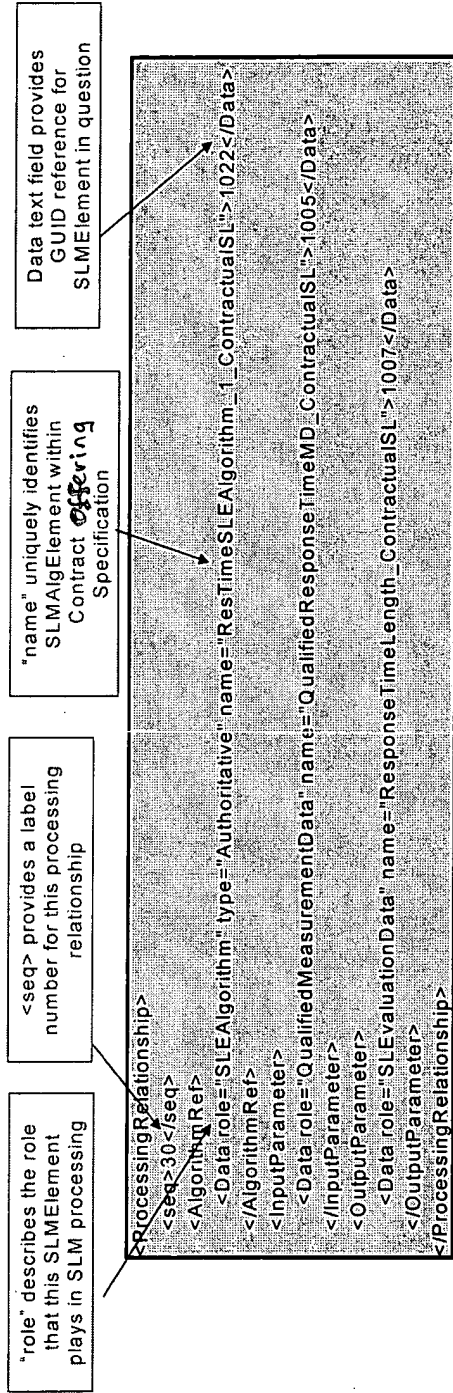


* Other implementations possible

** Optimization of data retrieval possible here

FIG. 20

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The flow knowledge base describes a relationship that exists between the "Qualified Measurement Data" and the "SL Evaluation Data" (ResponseTimeLength working data). The algorithm that facilitates this relationship is a "Service Level Evaluation (SLE) Algorithm" (ResTimeSLEAlgorithm_1_ContractualSL)

FIG. 21

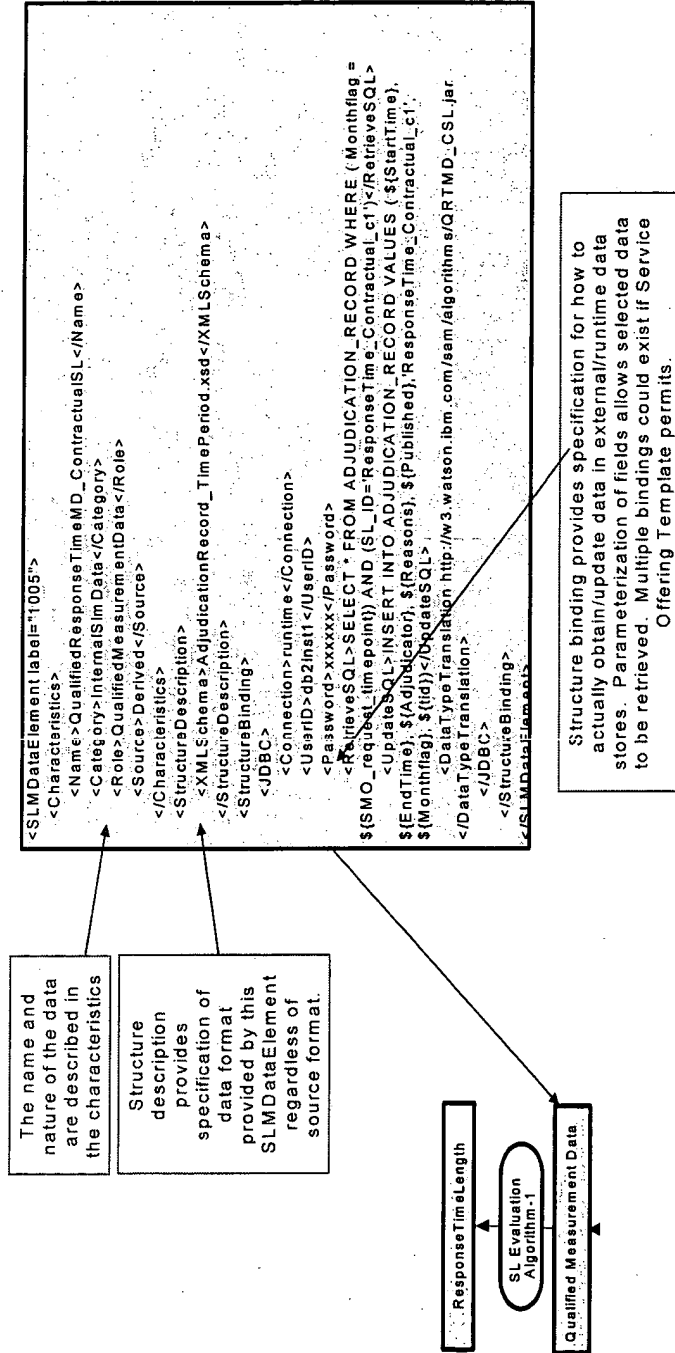


FIG. 22

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```

<QualifiedResponseTimeMD_ContractualSL>
  <entry>
    <STARTTIME>2003-07-01 16:00:00.0</STARTTIME>
    <ENDTIME>2003-07-01 16:20:00.0</ENDTIME>
    <ADJUDICATOR>nianhua</ADJUDICATOR>
    <REASONS>network down</REASONS>
    <PUBLISHED>1</PUBLISHED>
    <SL_ID>ResponseTime_Contractual_c1</SL_ID>
    <MONTHFLAG>2003-07-01 00:00:00.0</MONTHFLAG>
    <TID>100001</TID>
  </entry>
  <entry>
    <STARTTIME>2003-07-02 16:00:00.0</STARTTIME>
    <ENDTIME>2003-07-02 16:20:00.0</ENDTIME>
    <ADJUDICATOR>nianhua</ADJUDICATOR>
    <REASONS>network down</REASONS>
    <PUBLISHED>1</PUBLISHED>
    <SL_ID>ResponseTime_Contractual_c1</SL_ID>
    <MONTHFLAG>2003-07-01 00:00:00.0</MONTHFLAG>
    <TID>100002</TID>
  </entry>
  ...
</QualifiedResponseTimeMD_ContractualSL>

```

The data format was described by the structure description AdjudicationRecordTimePeriod.xsd (not shown)

Five data records were returned (two shown) when data specification was accessed for retrieval. The data was extracted from the runtime store, since it is in the middle of processing sequence

The QualifiedResponseTimeMD_ContractualSL is a data set presumed to exist in the runtime data store as described per the schema and extracted/updated per the SLMDataElement

FIG. 23

```

<SLMAlgElement label="1022">
  <Characteristics>
    <Name>ResTimeSLEAlgorithm_1ContractualSL</Name>
    <Category>InternalSimData</Category>
    <Role>SLEAlgorithm</Role>
  </Characteristics>
  <AlgorithmSub>
    <Input name="StartTime" dataType="Dynamic">
      <SLMElement>QualifiedResponseTimeMD_ContractualSL</SLMElement>
    </Input>
    <Input name="EndTime" dataType="Dynamic">
      <SLMElement>QualifiedResponseTimeMD_ContractualSL</SLMElement>
    </Input>
    <Output name="DurationValue" dataType="Dynamic">
      <SLMElement>ResponseTimeLength</SLMElement>
    </Output>
    <Input name="DurationUnit" dataType="Static">min</Input>
    <Input name="InputMonthflag" dataType="Dynamic">
      <SLMElement>QualifiedResponseTimeMD_ContractualSL</SLMElement>
    </Input>
    <Output name="OutputMonthflag" dataType="Dynamic">
      <SLMElement>responseTimeLength_ContractualSL</SLMElement>
    </Output>
  </AlgorithmSub>
  <ExecutionContext languages="JavaBean">
    <URI>http://w3.watson.ibm.com/sam/algorithm/s/TimeDurationAlg.jar</URI>
    <Translation />
  </ExecutionContext>
</SLMAlgElement>

```

The name and nature of the algorithm are described in the characteristics

The nature of each input and output parameter for the algorithm are described. Dynamic means it's described in an SLMDataElement. Static means it's described here.

Location and nature of actual algorithm that fulfils this processing step

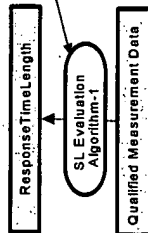


FIG. 24A

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```

<SLMAIgElement label="1021">
  <Characteristics>
    <Name>ResTimeSLEAlgorithm_ContractualSL</Name>
    <Category>SLaData</Category>
    <Role>SLEAlgorithm</Role>
  </Characteristics>
  <AlgorithmDescription>
    <AlgorithmType>PercentCompletedInTimeAlg</AlgorithmType>
    <Comment>
      [1]get all the entries from ${DividentSource} within ${TimeInterval},
      entry data unit is ${DividentSourceUnit}
      [2]count the number of above entries whose values are
      ${DividentFilterComparator} ${DividentFilterThreshold} ${DividentFilterUnit},
      [3]count the total number of entries from ${DivisorSource} within ${TimeInterval}
      [4]divide the result of step [2] by the result of step [3]
      [5]th result of step [4] is ${ResultValue}, the data unit should be ${ResultUnit}.
    </Comment>
    <Input name="DividentSource" dataType="Dynamic">
      <SLMEleName>'Qualified Measurement Data for On Demand Storage Provisioning Response Time'</SLMEleName>
      <AttrName>'completion_confirmation_timestamp' - request_timestamp'</AttrName>
    </Input>
    <Input name="DividentSourceUnit" dataType="Static">min</Input>
    <Input name="DividentFilterComparator" dataType="Static">le</Input>
    <Input name="DividentFilterThreshold" dataType="Static">30</Input>
    <Input name="DividentFilterUnit" dataType="Static">min</Input>
    <Input name="DivisorSource" dataType="Dynamic">
      <SLMEleName>'Qualified Measurement Data for On Demand Storage Provisioning Response Time'</SLMEleName>
      <AttrName>'completion_confirmation_timestamp' - request_timestamp'</AttrName>
    </Input>
    <Input name="TimeInterval" dataType="Static">monthly</Input>
    <Input name="ResultUnit" dataType="Static">percentage</Input>
    <Output name="ResultValue" dataType="Dynamic">
      <SLMEleName>'OnTimeRequestPercent_ContractualSL'</SLMEleName>
      <AttrName>'OnTimeRequestPercent'</AttrName>
    </Output>
  </AlgorithmDescription>
</SLMAIgElement>

```

FIG. 24B

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```

<SLMAIlgElement label="1023">
  <Characteristics>
    <Name>ResTimeSLEAlgorithm_2_ContractualSL</Name>
    <Category>InternalSimData</Category>
    <Role>SLEAlgorithm</Role>
  </Characteristics>
  <AlgorithmStub>
    <!-- mapping between SLMDDataElement name and the parameter names of algorithm script -->
    <Input name="DividentSource" data Type="Dynamic">
      <SLMEIeName>ResponseTimeLength_ContractualSL</SLMEIeName>
      <AttrName>ResponseTimeLength</AttrName>
    </Input>
    <Input name="DividentSourceUnit" data Type="Static">min</Input>
    <Input name="DividentFilterComparator" data Type="Static">le</Input>
    <Input name="DividentFilterThreshold" data Type="Static">30</Input>
    <Input name="DividentFilterUnit" data Type="Static">min</Input>
    <Input name="DivisorSource" data Type="Dynamic">
      <SLMEIeName>ResponseTimeLength_ContractualSL</SLMEIeName>
      <AttrName>ResponseTimeLength</AttrName>
    </Input>
    <Input name="TimeInterval" data Type="Static">monthly</Input>
    <Input name="ResultUnit" data Type="Static">percentage</Input>
    <Output name="ResultValue" data Type="Dynamic">
      <SLMEIeName>OnTimeRequestPercent_ContractualSL</SLMEIeName>
      <AttrName>OnTimeRequestPercent</AttrName>
    </Output>
    <Input name="InputMonthflag" data Type="Dynamic">
      <SLMEIeName>ResponseTimeLength_ContractualSL</SLMEIeName>
      <AttrName>Monthflag</AttrName>
    </Input>
    <Output name="OutputMonthflag" data Type="Dynamic">
      <SLMEIeName>OnTimeRequestPercent_ContractualSL</SLMEIeName>
      <AttrName>Monthflag</AttrName>
    </Output>
  </AlgorithmStub>
  <ExecutionContext language="JavaBean">
    <URL>file:///home/niall/July/DataManager/FlowDataExecutor/PercentCompletedInTimeAlg.jar</URL>
    <Translation/>
  </ExecutionContext>
</SLMAIlgElement>

```

FIG. 24C

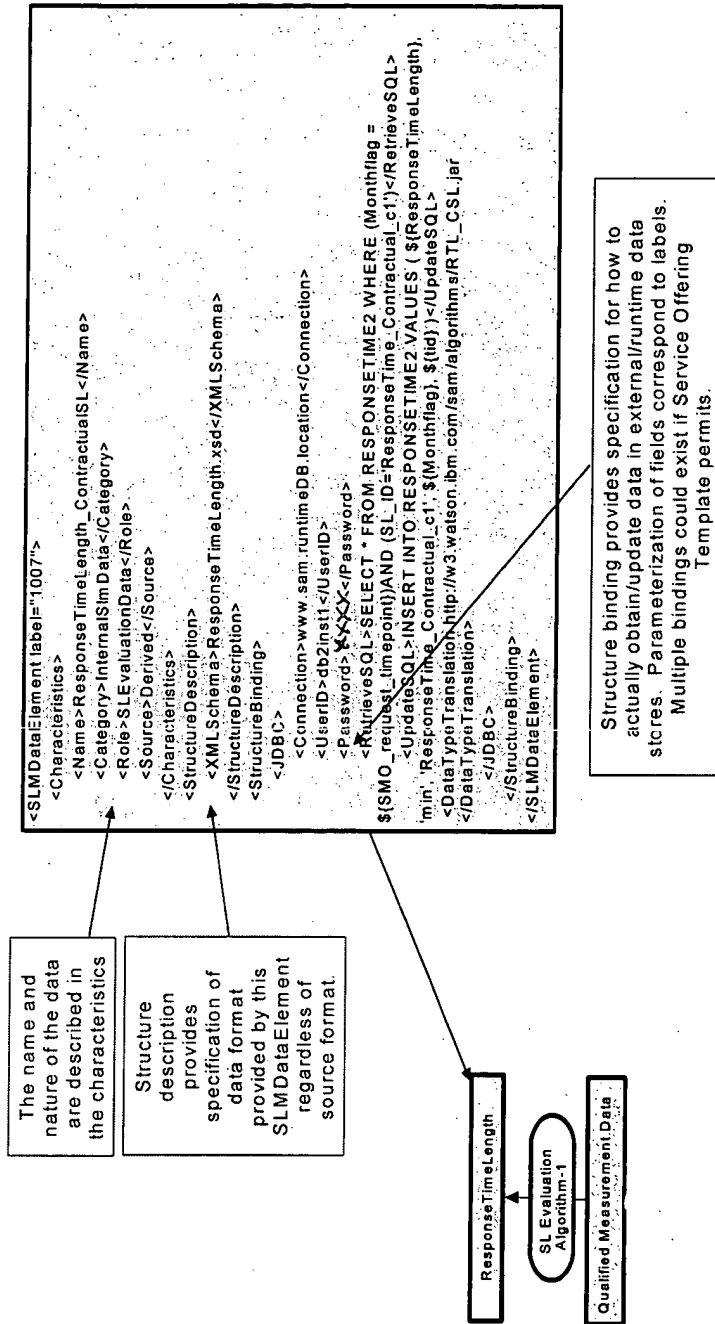
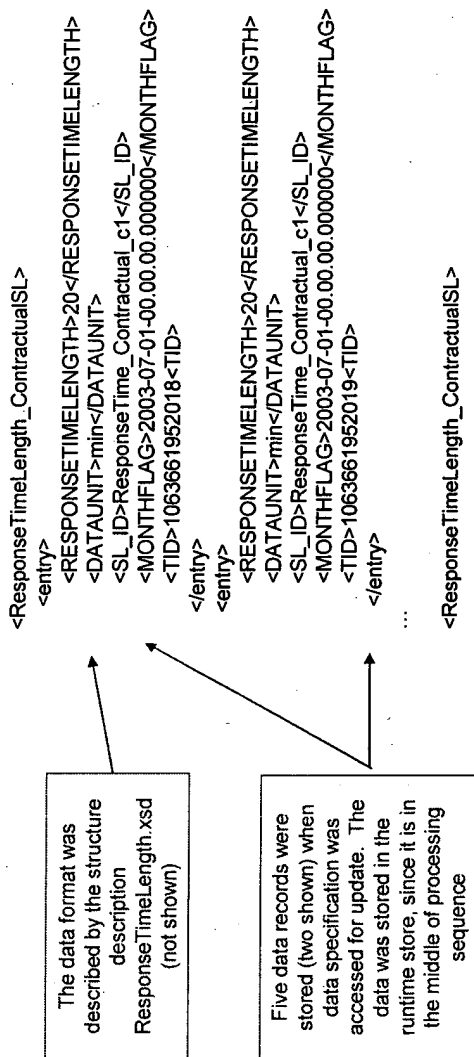


FIG. 25

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The ResponseTimeLength_ContractualSL is a data set that will exist in the runtime data store as described per the schema and is extracted/updated per the SLMDDataElement

FIG. 26

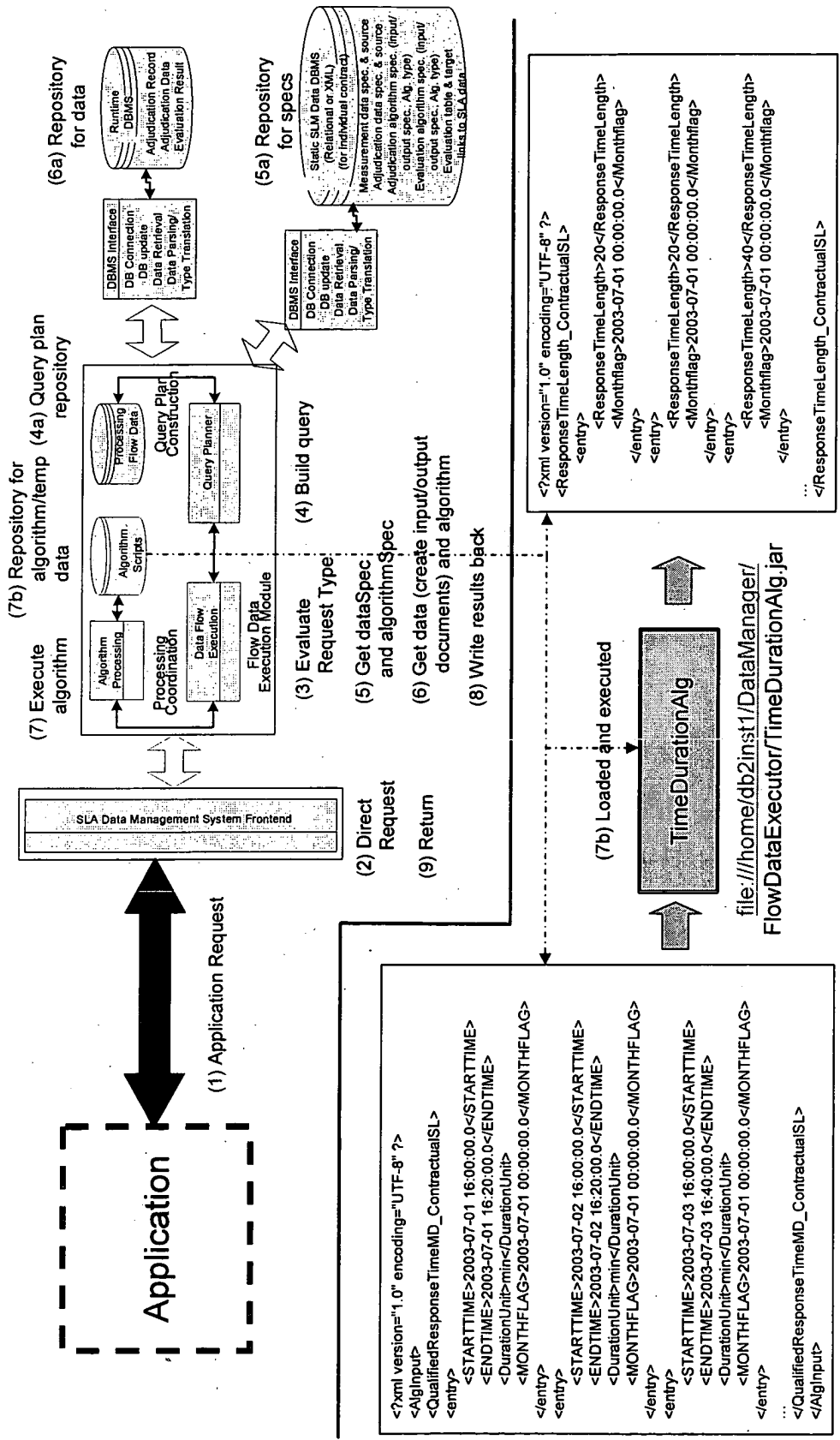


FIG. 27

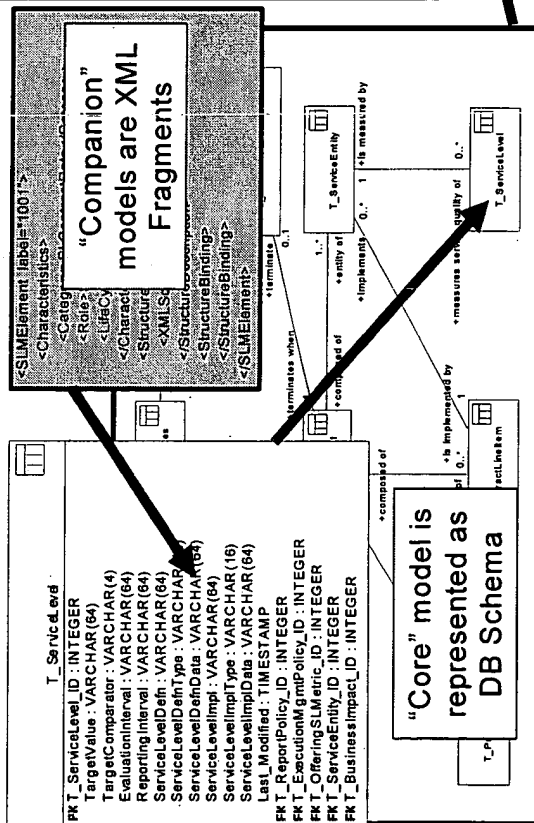
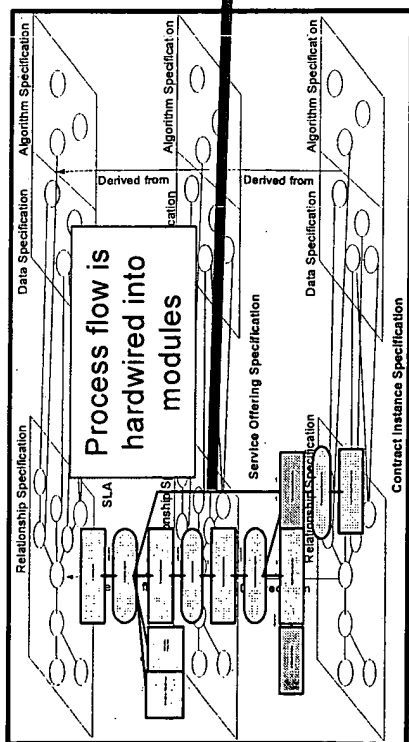
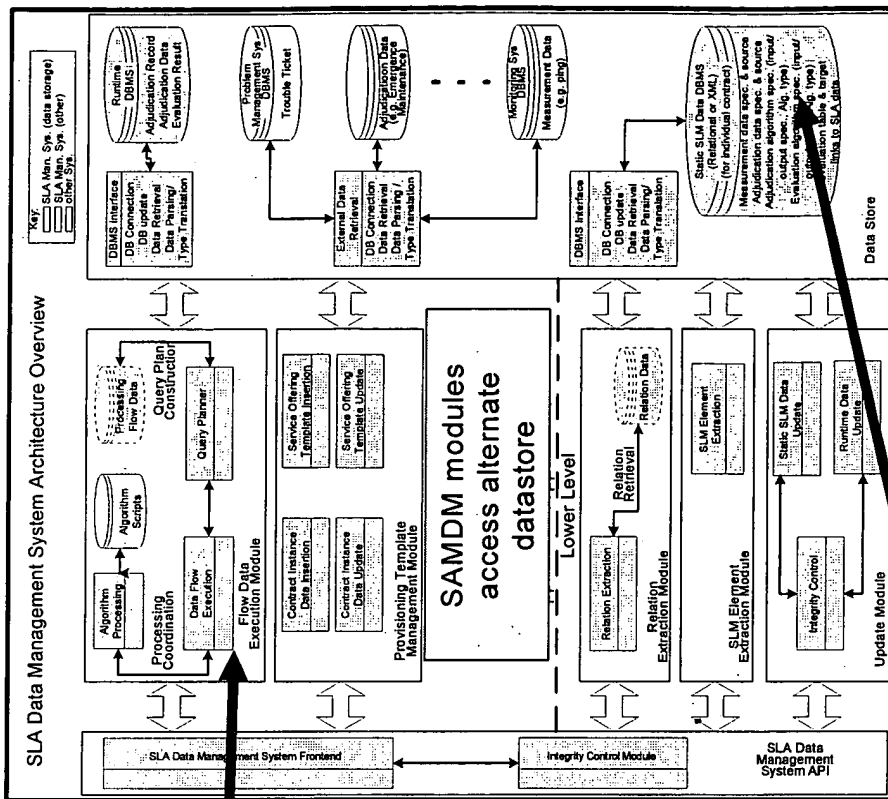


FIG. 28